§ 112 rejection

Claims 6 and 7-14 were rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite. More particularly, the Office Action asserted that the claimed generating step in claims 6 and 7-14 was unclear. Applicant has amended claims 6 and 7-14 to clarify the nature of the claimed generating steps. These amendments are formal in nature only and are not intended to change the scope of the claims or limit their range of equivalents. Withdrawal of the rejection is therefore respectfully requested.

§ 103 rejections

Claims 1, 3, and 18 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable under U.S. Patent No. 5,201,841 to Lebeau ("Lebeau") in view of U.S. Patent No. 6,000,844 to Cramer et al. ("Cramer"). Applicant respectfully traverses this rejection.

Lebeau does not disclose or suggest applying a force "to the specimen, wherein *the magnitude of the force* is sufficient to exacerbate a thermal discontinuity cause by a subsurface defect." (emphasis added). Lebeau is not concerned about the magnitude of the mechanical force which is to be applied to the specimen, but only requires that a mechanical force of some magnitude be applied. Lebeau is not concerned with the magnitude of the applied force because the applied force is not relied upon for the "work" that it does to the specimen, but rather is relied upon merely as a means for measuring propagation time through the specimen. The propagation time of the mechanical force is a surrogate used in place of heating the bond under consideration (Lebeau column 3, lines 1-32). In contrast to Lebeau, the invention set forth in claims 1, 3, and 18 must

be capable of employing a force of sufficient magnitude so as to "exacerbate the thermal discontinuity" cause by a subsurface defect of the specimen.

In summary, Lebeau's teachings of using a mechanical disturbance and measuring the propagation time of the disturbance for measuring bond strength is totally devoid of any suggestion of using a mechanical disturbance of sufficient magnitude to "exacerbate a thermal discontinuity."

The impact source 26 in Lebeau is not used to perform work on subsurface defect so as to exacerbate a thermal discontinuity therein. Instead, the impact source is used only to generate a mechanical disturbance for the sole purpose of measuring the propagation time therethrough.

Combining Lebeau with Cramer still would not render the claimed invention obvious because Cramer does not recognize the existence of kissing unbond sub-surface defects in a sample. Instead, Cramer assumes that sub-surface defects necessarily resist thermal energy diffusion (col. 4, lines 4-7) and fails to recognize that a kissing unbond defect will behave thermally like non-defective material if the walls of the defect are not physically separated by, for example, an applied force.

At best, combining Lebeau with Cramer in the manner suggested by the Office Action would result in a device that detects bond integrity either by sampling a thermal signature emitted from a specimen or by measuring the speed at which an applied mechanical wave travels through the sample. Neither of these options remotely suggests the claimed invention, which specifically recites that the applied force creates and/or exacerbates a thermal discontinuity in the sample to render the defect detectable

through thermal imaging. Claims 1, 3 and 18 are therefore patentable, and withdrawal of the rejection is respectfully requested.

Claims 2, 4, 15-16 and 23 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Lebeau and Cramer as applied to claims 1, 3 and 18 and further in view of U.S. Patent No. 5,587,532 to Rose ("Rose") and U.S. Patent No. 4,752,140 to Cielo et al. ("Cielo"). Applicant respectfully traverses this rejection. Claims 2, 4 and 23 depend on patentable claim 1 or 18 and are therefore patentable for the reasons explained above.

The Office Action admitted that the combination of Lebeau and Cramer does not specifically disclose applying decreased air pressure onto a specimen or using a vacuum to exacerbate a sub-surface defect, but asserted that Rose teaches placing the specimen in a sealed chamber and that Cielo teaches applying a vacuum, thereby suggesting the claimed invention. Applicant respectfully disagrees.

As explained above, the combination of Lebeau and Cramer fails to teach the claimed invention because it does not suggest a thermal imaging system that applies a force to the sample to create and/or exacerbate a thermal discontinuity. Nothing in Rose, Cielo or any of the references of record, make up for this shortcoming. There is no motivation to add Rose to the combination because Rose focuses solely on detecting acoustic signals caused by changes in the gas pressure within a sealed chamber to detect cracks in a ceramic (col. 5, lines 14-44). The gas pressure changes are due to the manner in which gas travels through cracks in a ceramic (col. 5, lines 38-44) and are <u>not</u> due to any outside pressure (or vacuum) regulation, contrary to the Office Action's assertion.

There is no reason why one of ordinary skill in the art would have combined Rose's sealed chamber with Lebeau and Cramer, particularly because Rose detects defects using gas pressure-inducted acoustic signals and not on temperature-related methods like Lebeau and Cramer. Further, there is no motivation to add Cielo to the combination because to do so destroys a primary objective of Rose which is the propagation of acoustic signals through the gas medium which envelopes the specimen. As soon as Cielo is combined with Rose, the gas is evacuated from the chamber thereby making the chamber devoid of any acoustic carrying medium and rendering it unable to propagate acoustic waves. Cielo teaches that deformation via vacuum or vibration is not particularly desirable (see, e.g., col. 1, line 51 to col. 2, line 19) and focuses instead on conducting vertical displacement with a thermal radiation pulse, making Rose's gas-tight chamber irrelevant. Thus, it would not have been obvious to combine Cielo and Rose together, much less add this combination to the Lebeau/Cramer combination suggested by the Examiner. Claims 2, 4, 15-16 and 23 are therefore patentable, and withdrawal of the rejection is respectfully requested.

Claims 19-22 and 24-26 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Lebeau, Cramer, Rose and Cielo as applied to claims 1-6, 15-16 and 23 and further in view of an article entitled "Thermography and Ultrasonic Finds Flaws in Composites" ("the Article"). Applicant respectfully traverses this rejection. Claims 19-22 and 24-26 depend on patentable claim 18 and are therefore patentable for the reasons explained above. Further, adding the Article to the combination suggested by the Office Action still would not suggest the claimed invention because

the Article only discusses the use of flash lamps in non-destructive inspection and does not remedy any of the deficiencies in the other references as noted above. Claims 19-22 and 24-26 are therefore patentable, and withdrawal of the rejection is respectfully requested.

Claims 27-28 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Lebeau and Cramer as applied to claims 1, 3 and 18 above and further in view of U.S. Patent No. 5,709,469 to White et al. ("White"). Applicant respectfully traverses this rejection. Claims 27 and 28 depend on patentable claim 18 and are therefore patentable for the reasons explained above. As explained above with respect to claim 18, neither Lebeau nor Cramer, either alone or in combination, suggest obtaining a thermal image of a sample as a force is applied on the sample to create a thermal discontinuity. Adding White to the combination still would not suggest the claimed invention because White only discloses a heat lamp and completely fails to address the deficiencies of Lebeau and Cramer as explained above. Claims 27-28 are therefore patentable, and withdrawal of the rejection is respectfully requested.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance, and a Notice to that effect is earnestly solicited.

Any fees associated with the filing of this paper should be identified in any accompanying transmittal. However, if any additional fees are required, they may be charged to Deposit Account 18-0013 in the name of Rader, Fishman & Grauer PLLC.

Respectfully submitted,

Joseph V. Coppola, Sr. Reg. 33373
Anna M. Shih, Reg. 36372
RADER, FISHMAN & GRAUER PLLC
39533 Woodward Avenue
Suite 140
Bloomfield Hills, MI 48304
(248) 594-0650
CUSTOMER NO. 010291

MARKED UP VERSION OF ALL AMENDED CLAIMS

1. (First Amended) A method for non-destructive evaluation of a specimen, comprising the steps of:

[directing heat onto]heating the specimen;

applying a force [onto a surface of]to the specimen, wherein the magnitude of the force is sufficient to exacerbate a thermal discontinuity caused by a subsurface defect of said specimen; and

generating an infrared image to detect the presence of a subsurface defect[, wherein the application of the force onto the surface of the specimen exacerbates a thermal discontinuity proximate to the subsurface defect].

6. (First amended) The method of claim 5, wherein the sealed enclosure is divided into two sections such that the vacuum generated in said vacuum generating step produces a vacuum in one of the two sections.

7. (First amended) The method of claim 1, wherein said applying step includes increasing and decreasing the [pressure]force on the specimen surface, wherein said image generating step includes generating a first thermographic image when the [pressure]force is increased and generating a second thermographic image when the [pressure]force is decreased, and wherein the method further comprises the step of comparing the first and second [active]thermographic images to detect the subsurface defect.

8. (First amended) The method of claim 7, wherein the image generating step generates a plurality of first thermographic images and a plurality of second thermographic

images over time, and wherein the comparing step is conducted by calculating the difference of the sums of the first thermographic images and the second thermographic images.

9. (First amended) The method of claim 7, wherein the image generating step generates a plurality of first thermographic images and a plurality of second thermographic images over time, and wherein the comparing step includes generating histograms corresponding to the plurality of first and second thermographic images and comparing the histograms for the plurality of first thermographic images with the histograms for the plurality of second thermographic images.

10. (First amended) The method of claim 7, wherein the image generating step generates a plurality of first thermographic images and a plurality of second thermographic images over time, and wherein the comparing step includes mathematically correlating the plurality of first thermographic images with the plurality of second thermographic images.

11. (First amended) The method of claim 7, wherein the image generating step generates a plurality of first thermographic images and a plurality of second thermographic images over time, and wherein the comparing step includes viewing an image corresponding to the ratio between the plurality of the first thermographic images and the plurality of the second thermographic images.

12. (First amended) The method of claim 7, wherein the image generating step generates a plurality of first thermographic images and a plurality of second thermographic images over time, and wherein the comparing step includes visually comparing the plurality of first thermographic images and the plurality of second thermographic images.

13. (First amended) The method of claim 7, wherein the applying step includes placing the specimen in a chamber before said image generating step.

14. (First amended) The method of claim 7, wherein the applying step includes placing a sealed enclosure on the specimen surface before said image generating step.

15. (First amended) A method for non-destructive evaluation of a specimen, comprising the steps of:

[directing heat onto]heating the specimen;

placing a sealed enclosure on [the specimen surface] a surface of the specimen;

applying a vacuum to at least a portion of [a]the surface of the specimen by decreasing the air pressure in the sealed enclosure, wherein the vacuum from the applying step enlarges at least one dimension of the subsurface defect to create a thermal discontinuity; and

generating an infrared image to detect the presence of a subsurface defect[, wherein the vacuum from the applying step enlarges at least one dimension of the subsurface defect to create a thermal discontinuity].

18. (First Amended) An apparatus for non-destructive evaluation of a specimen, comprising:

a heat-sensitive image generator that generates thermographic images;

a heater that increases the temperature of the specimen; and

means for applying a force to [a surface of] the specimen, wherein the applying means changes at least one dimension of a subsurface defect in the specimen to create a thermal discontinuity.

20. (First amended) The apparatus of claim 18, wherein said [distorting] applying means includes:

a sealed enclosure that is placed on the specimen's surface; and

a vacuum pump that generates a vacuum inside the sealed enclosure.

23. (First amended) The apparatus of claim 18, wherein said [distorting] applying means includes:

a chamber for holding the specimen; and

a vacuum pump that generates a vacuum inside the chamber.